Using the TI-83 or TI-84 PLus Graphics Calculators to solve problems involving binomial, Poisson, or normal probability distributions.

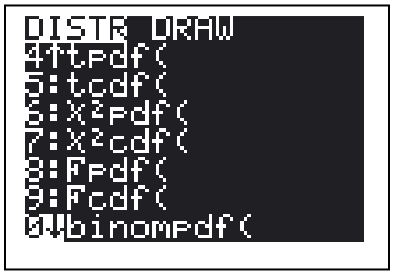
Determining binomial probabilities

The binomal distribution is defined by two parameters, n, the number of independent trials and p, the probability of success for any one of the trials.

Examples

1. Given that we have a binomial distribution, evaluate Pr(X= 5) for n= 8 and p = 0.4.

Start on the HOME screen (press 2nd MODE [QUIT]if you are not on the home screen). Press CLEAR if necessary. Press 2nd VARS [DISTR] and use the ▼ to move down the DISTR menu to option 0: **binompdf(** and press ENTER. **Or** alternatively press 0 on the DISTR menu.



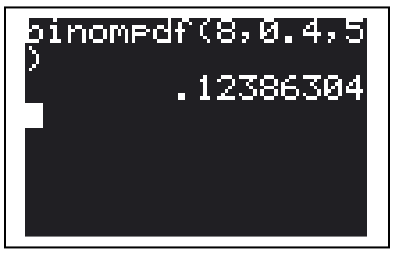
Both methods paste the binomial probability distribution function command onto the screen.

The order to enable the calculator to evaluate the answer is (n, p, x) where x is the number of successes.

So type in 8 , 0.4 , 5) and press ENTER to evaluate.

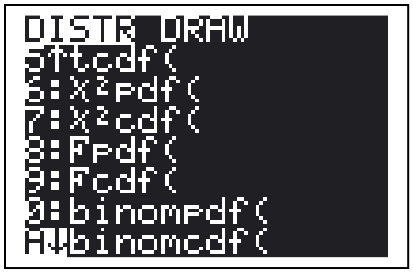
Thus we have

Pr(X=5) = 0.1239 (4d.p.)



2. Evaluate Pr($X \leq 10$) for a binomial distribution where n= 15 and p = 0.6.

Start on the HOME screen (press 2nd MODE [QUIT]if you are not on the home screen). Press CLEAR if necessary. Press 2nd VARS [DISTR] and use the ▼ to move down the DISTR menu to option A: **binomcdf(** and press ENTER . **Or** alternatively you can press ALPHA MATH [A] on the DISTR menu.



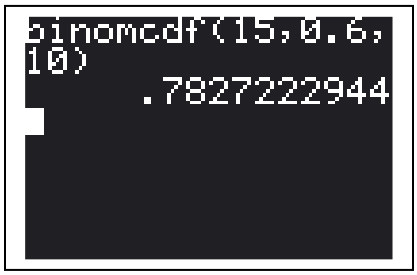
Both methods will paste the binomial cumulative probability distribution function to the screen.

The order to enable the calculator to evaluate the answer is (n, p, x) where x is the upper limit for the number of successes.

So type in 15 , 0.6 , 10) and press ENTER to evaluate.

Thus we have

$$\Pr(X \leq 10) = 0.7827 \text{ (4d.p.)}$$



3. Evaluate Pr ($X \geq 6$) for a binomial distribution where n= 18 and p = 0.55.

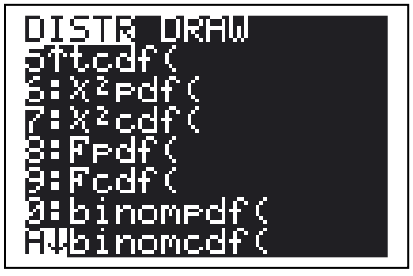
The calculator cannot evaluate this probability directly, but we can make use of the fact that

$$\Pr(X \geq 6) = 1 - \Pr(X \leq 5)$$

Start on a clear HOME screen.

Type in 1 −
You must do this before entering the binomcdf.

Press 2nd VARS [DISTR] and use the ▼ to move down the DISTR menu to option A: **binomcdf(** and press ENTER . **Or** alternatively you can press ALPHA MATH [A] on the DISTR menu..



Both methods will paste the binomial cumulative probability distribution function to the screen.

The order to enable the calculator to evaluate the answer is (n, p, x) where x is the upper limit for the number of failures.

So type in 18 [,] 0.55 [,] 5 [)] and press [ENTER] to evaluate.

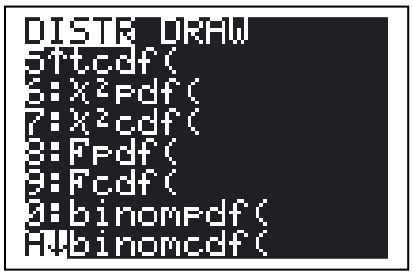
Thus we have

$$\Pr(X \geq 6) = 0.9817 \text{ (4d.p.)}$$

4. Evaluate $\Pr(4 \leq X \leq 8)$ for a binomial distribution where n =15 and p = 0.4.

The calculator cannot evaluate this probability directly, but we can make use of the fact that

$$\Pr(4 \leq X \leq 8) = \Pr(X \leq 8) - \Pr(X \leq \mathbf{3})$$



Start on a clear HOME screen.

Press [2nd] [VARS] [DISTR] and use the [▼] to move down the DISTR menu to option **A**: **`binomcdf(`** and press [ENTER] .
Or alternatively you can press
[ALPHA] [MATH] [A] on the DISTR menu.

Both methods will paste the binomial cumulative probability distribution function to the screen.

Type in 15 [,] 0.4 [,] 8 [)] [−] and then go back through the DISTR menu and paste another **`binomcdf(`**
command to the screen. Now type in 15 [,] 0.4 [,]3 [)]
and press [ENTER].

Thus we have

$$\Pr(4 \leq X \leq 8) = 0.8145 \text{ (4d.p.)}$$

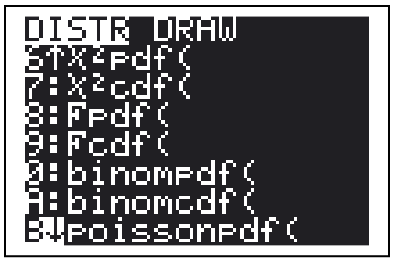
Determining Poisson probabilities

The Poisson distribution is defined by a single parameter λ, the mean number of occurrences of the event over a given interval.

Examples

1. Given that we have a Poisson distribution with λ = 3, evaluate Pr(X = 4).

Start on a clear HOME screen. Press 2nd VARS [DISTR] and use the ▼ to move down the DISTR menu to **B:poissonpdf(** and press ENTER.



The Poisson probability distribution function command will be pasted onto the screen. Type in 3 , 4) and press ENTER to evaluate.

We see that Pr(X = 4) = 0.1680 (4d.p.)

2. Evaluate Pr(X ≤ 5) if X is a Poisson distribution with λ = 4.

Start on a clear HOME screen. Press 2nd VARS [DISTR] and ▼ the DISTR menu to **C:poissoncdf(** and press ENTER. Type in 4 , 5) and press ENTER.

We see that Pr(X ≤ 5) = 0.7851 (4d.p.)

3. Evaluate Pr (X ≥ 3) if X is a Poisson distribution with λ = 4.

The calculator cannot evaluate this probability directly so we use the fact that

$$\Pr(X \geq 3) = 1 - \Pr(X \leq 2)$$

Start on a clear HOME screen. Type in 1 − then paste the **poissoncdf(** command to the screen and type in 4 , 2) followed by ENTER.

We see that Pr (X ≥ 3) = 0.7619 (4d.p.)

4. Evaluate Pr($3 \le X \le 8$) if X is a Poisson distribution with $\lambda = 5$.

This time do not clear the screen. Press [2nd] [VARS] [DISTR] and [▼] to **C:poissoncdf(** and press [ENTER]. Type in 5 [,] 8 [)] [−] then go through the DISTR menu again and paste the **poissoncdf(** command to the screen and type in 5 [,] 2 [)] followed by [ENTER].

We see that Pr($3 \le X \le 8$) = 0.8073 (4d.p.)

Here you can see that you will not need to clear the screen each time you have a different problem to solve, however it is a good idea initially so there is less on the screen.

Determining Normal Probabilities

The normal distribution is defined by two parameters μ, the mean value of X and σ^2, the variance of X.

Using the TI 83-Plus/TI-84 calculator the student can avoid having to calculate the z score and using the standard normal tables. However an initial explanation of the standard normal curve, what the z score is and that the probability relates to the area under the curve are important in the introduction of this work. Sketch graphs for problems should be included.

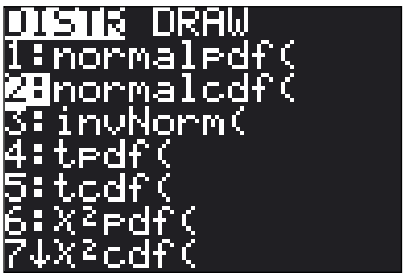
Examples

1. For a Normal distribution with $\mu = 45$ and $\sigma = 5$ find Pr($38 \le X \le 47$).

Start on the HOME screen (press [2nd] [MODE] [QUIT] if you are not on the home screen).

Press [CLEAR] if necessary.

Press [2nd] [VARS] [DISTR] and use the [▼] to move down the DISTR menu to option 2: **normalcdf(** and press [ENTER]. **Or** alternatively press [2] on the DISTR menu.

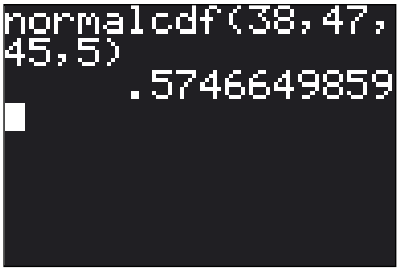


The normalcdf command will be pasted onto the screen.

The order for the Normal Continuous Distribution Function is

(lower bound, upper bound, μ, σ)

Now type in 38 [,] 47 [,]45 [,] 5 [)] and press [ENTER].



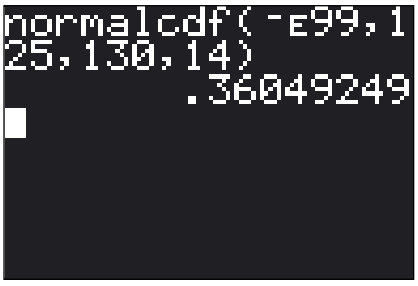
This gives Pr($38 \le X \le 47$) = 0.5747 (4d.p.)

2. Evaluate Pr ($X \leq 125$) for a normal distribution with $\mu = 130$ and $\sigma = 14$.

To evaluate Pr ($X \leq 125$) we need to set a very small value for the lower limit. For this we can use – E99 which is 10^{-99}. You can alternatively put in say -10000.

Starting on the Home screen press [2nd] [VARS] [DISTR] and use the [▼] to move down the DISTR menu to option 2: **normalcdf(** and press [ENTER].
Or alternatively press [2] on the DISTR menu.

The normalcdf command will be pasted onto the screen.
Now press [(-)] [2nd] [,] [EE] 99 [,] 125 [,] 130 [,] 14 [)] [ENTER].

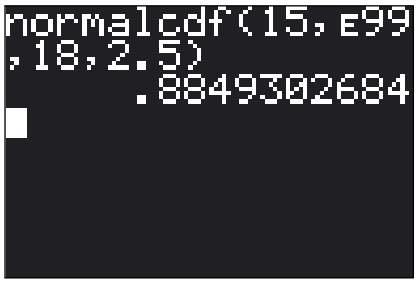


This gives Pr ($X \leq 125$) = 0.3065 (4d.p.)

3. Evaluate Pr($X \geq 15$) for a normal distribution with $\mu = 18$ and $\sigma = 2.5$.

To evaluate Pr($X \geq 15$) we need to set a very large value for the upper limit. For this we can use E99 which is 10^{99}. You can alternatively put in 10000.

Start on the Home screen and press [2nd] [VARS] [DISTR] and use the [▼] to move down the DISTR menu to option 2: **normalcdf(** and press [ENTER].
Or alternatively press [2] on the DISTR menu.



The normalcdf command will be pasted to the screen.

Now type in 15 [,] [2nd] [,] [EE] 99 [,] 18 [,] 2.5 [)] and [ENTER].

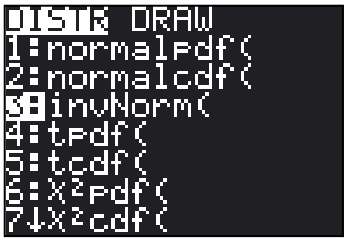
This gives Pr($X \geq 15$) = 0.8849 (4d.p.)

Inverse normal problems

Examples
A certain brand of chocolate bar are labelled as weighing 150g. In fact the weights of this particular chocolate bar have been found over a period of time to be normally distributed with a mean of 153g and a standard deviation of 1.7g.

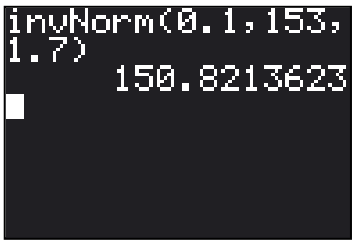
1. Find the weight below which 10% of the bars will be. Here we are finding x such that $Pr(X < x) = 0.1$

Press [2nd] [VARS] [DISTR] and [▼] to 3:**invNorm(**
and press [ENTER]. **Or** alternatively press [3] on the DISTR menu.



The invNorm command will be pasted to the screen.

The order to enable the calculator to evaluate the answer is (p, μ, σ) where p is the probability less than x.



Now type in 0.1 [,] 153 [,] 1.7 [)]and [ENTER].

This means that 10% of the chocolate bars weigh less than 150.82g. (2d.p.)

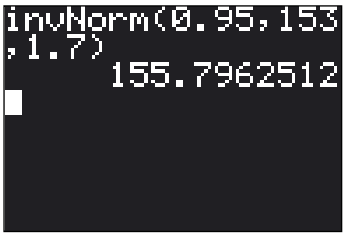
2. Find the weight above which only 5% of the bars will be.

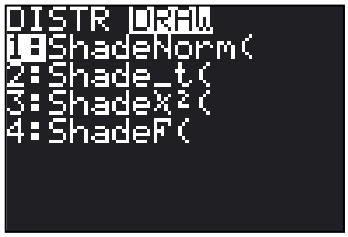
In this problem we want the weight below which 95% of the bars will be. This is because

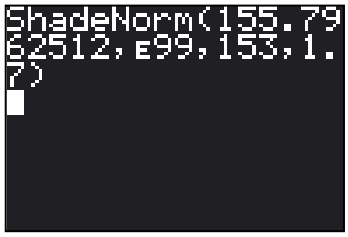
$$Pr(X \geq x) = 0.05 \text{ implies } Pr(X < x) = 0.95.$$

We then enter invNorm command as in example 1 above and values as in the screenshot below left. This means that 5% of bars will be above 155.80g. (2d.p.)

The screen shots below centre and right are used to display the supporting graph using shadeNorm which is found by pressing [2nd] [VARS] [DISTR] [▸] to DRAW [ENTER]. For this we enter the lower bound which we have just found, upper bound as E99, which is 10^{99}, followed by the mean and standard deviation.

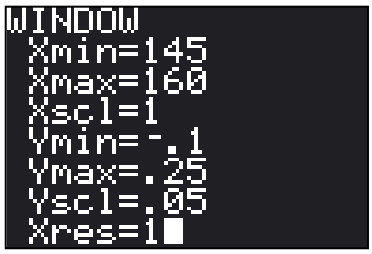






Of course to get the graph we have to set the window correctly, ensure that Plots are off and that no equations are in the [Y=] screen.

To set the viewing window press [WINDOW] and set Xmin =145, Xmax =160, Xscl = 1, Ymin = -0.1, Ymax = 0.25, Yscl = 0.05 Xres = 1.



The format here is to set the domain to $\mu \pm 4\sigma$, the Ymin to a small negative value (so that the on-screen text will not partially obscure the curve), Ymax $\approx 0.5/\sigma$ and an appropriate value for Yscl.

Press [2nd] [MODE] [QUIT] to return to the home screen which will have the shadeNorm command then [ENTER] to draw the curve. If the command has elapsed from the home screen, press [2nd] [ENTER] to replay it, then [ENTER] to execute.